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Citation for final published version:

Al Masan, Ammar, Dummer, Paul ORCID: <https://orcid.org/0000-0002-0726-7467>, Farnell, Damian ORCID: <https://orcid.org/0000-0003-0662-1927> and Vianna, Morgana 2018. Antibiotic-prescribing for endodontic therapies: a comparative survey between general dental practitioners (GDPs) and final-year Bachelor of Dental Surgery (BDS) students in Cardiff, UK. International Endodontic Journal 51 (7) , pp. 717-728. 10.1111/iej.12887 file

Publishers page: <http://dx.doi.org/10.1111/iej.12887>
<<http://dx.doi.org/10.1111/iej.12887>>

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Antibiotic-prescribing for endodontic therapies: a comparative survey between general dental practitioners (GDPs) and final-year Bachelor of Dental Surgery (BDS) students in Cardiff, UK

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Running title: Antibiotic-prescribing for endodontic therapies

Key words: antibiotics, antibiotic prescription, antibiotics in endodontics, antibiotics indication, symptomatic pulpitis, general dental practitioners, Bachelor of Dental Surgery, dental pain, dental infection, survey

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Abstract

Aim: To evaluate the views of final-year dental surgery (BDS; G1) students at Cardiff University and general dental practitioners (GDPs; G2) within the city of Cardiff, Wales on antibiotic prescribing for endodontic conditions, and investigate the potential differences between the two groups.

Methods: A cross-sectional online questionnaire-based survey of 12 qualitative and quantitative questions was distributed to 76 final-year BDS Cardiff University students and 55 dental practices within Cardiff, UK. Six questions recorded general information and the remaining questions included a series of hypothetical clinical scenarios, where the participants were asked to state whether they would or would not prescribe antibiotics. The data were analyzed using SPSS V23 to produce descriptive statistics, contingency tables, and to run Chi-Square (χ^2) tests, Fisher's-exact tests, and relative-risk calculations.

Results: The response rate was 60% ($n=79$). All G1 were aware of the consequences of antibiotic over-use. Approximately 60% were aware of guidelines for antibiotic use in endodontic therapies, and 83% would only use antibiotics for a limited selection of patients (e.g. patients with systemic complications). G1 responses to clinical-scenarios indicated overall that they were comparable to the ideal answers except for acute apical abscess (64% believed that antibiotics were indicated). The majority of G2 were aware of the consequences of antibiotic over-use. Only 28% of G2 were aware of guidelines for antibiotic use in endodontic therapies. Overall responses revealed that antibiotics would be prescribed for: systemic complications (78%), acute apical abscess (72%) and symptomatic apical periodontitis (28%). The clinical-scenarios revealed G1 were more likely to prescribe antibiotics compared to G2 for cases of necrotic pulps with symptomatic apical periodontitis without systemic complications (Q7, incorrect indication) and less likely to other clinical scenarios such as necrotic pulps and asymptomatic apical periodontitis for patients with a history of rheumatic fever (ideal answer), symptomatic irreversible/reversible pulpitis, failure to achieve anaesthesia chronic apical abscess for patients with diabetes. The recognition of antibiotic prescription for cases with signs of spreading infection was more evident in G2.

Conclusion: Final year undergraduate students were aware of the antibiotic resistance crisis, although a third were not aware of guidelines for use of antibiotics in endodontic conditions; their responses to clinical scenario were more compatible with the guidelines. General dentists were less aware of the implications of over-use of antibiotics and the existence of guidelines, and their responses were occasionally incompatible with antibiotic-guidelines for endodontic therapies.

Introduction

The misuse of antibiotics in agriculture, veterinary medicine, medicine and dentistry has contributed to the development of resistant bacterial species (Read & Woods 2014), which has led to the current global antibiotic resistance crisis (O'Neill 2016). Indeed, it is predicted that multi-drug resistant infections will result in thousands of deaths annually with a substantial economic impact (O'Neill 2016). In Europe, 80-90% of antibiotic prescriptions are for respiratory tract infections, which are self-limiting (Kenealy & Arroll 2013, Spinks *et al.* 2013, Llor & Bjerrum 2014, Smith *et al.* 2014, Segura-Egea *et al.* 2017, ESE 2017). Coordinated and cooperative international efforts are required to implement evidence-based policies/guidance and to provide clear detailed strategies to solve this crisis (VMD 2014, VMD 2015, O'Neil 2016, ESE 2017).

Dentists are responsible for 10% of antibiotic prescriptions in the UK (Sweeney *et al.* 2004). Studies have reported that 40% of UK dentists prescribe antibiotics three times a week, and 15% prescribe antibiotics daily (Lewis 2008). However, it has been shown that the majority of these prescriptions are inappropriate (Cope *et al.* 2015).

Antibiotics can be used for prophylaxis during invasive dental procedures in endodontics for patients with specific health conditions following a risk assessment (Wilson *et al.* 2007, NICE 2016, ESE 2017), and for specific situations such as: (a) evidence of spreading infection (cellulitis, lymph node involvement, diffuse swelling), (b) systemic involvement (fever, malaise) (SDCEP 2011, AAE 2016, ESE 2017, Segura-Egea *et al.* 2017), and (c) significant trismus (SDCEP 2011, AAE 2016, ESE 2017, Segura-Egea *et al.* 2017). Life-threatening situations, such as floor-of-mouth swelling or difficulty in breathing, should be managed in a hospital setting with the administration of intra-venous antibiotics (SDCEP 2011, AAE 2016, ESE 2017, Segura-Egea *et al.* 2017).

The current recommendations for antibiotic prescription in endodontics are guided by specialist endodontic associations, e.g. the American Association of Endodontists (AAE), the European Society of Endodontology (ESE), and dental bodies such as the Scottish Dental Clinical Effectiveness Programme (SDCEP). There is a consensus that local treatment measures are sufficient to contain endodontic infections, such as caries

excavation/restorations, pulpotomy, pulpectomy, surgical incision and drainage of soft tissue swellings, or extractions (SDCEP 2011, Sharif 2015, Walton 2016, AAE 2016, ESE 2017, Segura-Egea *et al.* 2017).

Final-year dental students cannot prescribe antibiotics during training, even though they will soon be qualified as general dental practitioners (GDPs). This group can provide evidence on what is learnt and assimilated during their education, which will be applied in their professional life. On the other hand, GDPs represent professionals who are subjected to various environmental factors, such as working-time pressure that has been described as one of the factors for inappropriate prescription of antibiotics (Cope *et al.* 2015). Therefore, the present study aimed to evaluate the views of dentists and final year BDS students in the Cardiff region of the UK on antibiotic prescribing for endodontic conditions.

Materials and methods

The study was approved by the Research Ethics Committee, School of Dentistry and University Dental Hospital (Reference: 16/35a). An online questionnaire was designed to be a mixture of qualitative and quantitative questions. A total of 131 invitations were sent to two groups; Group one (G1) were final year BDS students at Cardiff University ($n = 76$) and Group two (G2) consisted of general dental practitioners (GDPs) within the city of Cardiff, Wales, UK ($n = 55$). Invitations were sent individually via the Cardiff Dental School and Hospital (CDSH) undergraduate academic office for G1, and Cardiff University Academic Unit of the Postgraduate Medical and Dental Education Deanery (PGMDE) for G2. The online survey was opened from 30th September 2016 to 31st October 2016 and a reminder was sent two weeks after the study had been launched.

The questionnaire consisted of a mixture of 12 qualitative and quantitative questions (Table 1). The first 6 questions recorded general information such as age, year of graduation, dental school where graduated, number of patients seen each working day, number of endodontic emergency patients, and awareness of available antibiotic prescribing guidelines for endodontic therapies. The remaining questions included a series of hypothetical clinical scenarios, where the participants were asked to state whether they would or would not prescribe antibiotics. The correct answers were based on available guidelines for use of antibiotics at the

time of the survey (SDCEP 2011, AAE 2016, NICE 2016, Segura-Egea *et al.* 2017); the expected answers can be seen in Table 2.

Data analysis

Data were analyzed statistically using Statistical Package for the Social Sciences (SPSS) version 23 (International Business Machines Corporation, New York, USA). Contingency tables listing the numbers of responses to specific items were found and chi-square (χ^2) tests were used to determine if differences in the responses to these items were significantly different between the two groups G1 and G2. The Fisher's exact test was used to provide *P*-values in those cases when the chi-square test was not valid (i.e. when expected counts were less than 5), and this test should provide more reliable results when sample sizes are small. Relative risk (RR) coefficients and associated 95% confidence intervals (CI) were found also for all scenarios with respect to the two groups, G1 and G2. The qualitative collected data related to antibiotic prescribing for the various scenarios were explored to analyze/compare by formulating a simple thematic analysis. The results were triangulated with those quantitative responses to each imaginary clinical scenario.

Results

The total response rate was 60.3% consisting of 47 out 76 final year students in G1 (61.8%) and 32 out 55 dental practitioners in G2 (58.2%).

Table 3 shows the summary of responses for questions 1-6. All G1 participants were aware of the consequences of antibiotics (Q.6, *n* = 47; 100%). A total of 39 participants (Q.4, 83%) would prescribe antibiotics for limited selected patients and 47 (Q.4 II, 100%) would prescribe antibiotics for patients with systemic complications. However, only 28 students were aware of the guidelines for antibiotic prescribing for endodontic conditions (Q.5 I, 60%) and of those that were aware of the guidelines only 18 participants had actually read them (Q.5 II, 36%).

A total of 19 G2 participants graduated in the UK (Q.1, 84.4%). Most of the participants had more than 10 years of clinical experience (Q.2 II, *n*= 15, 46.9%), followed by 5-10 years (*n*= 10, 31.3%), and 1-5 years (*n*= 17, 21.9%). The majority of G2 reported they saw 10-40 patients day (Q.3 I) whereas the number of patients

seen by G1 ranged from 0-5 (Q.3 I, $n = 43$, 91.5%). The majority of the participants of both groups, G1 (100%) and G2 (90%), reported they saw 0-3 endodontic emergency patients per working day (Q.3 II).

The majority of G2 participants were aware of the consequences of over-use of antibiotics (Q.6, 95.9%) and answered that they would only prescribe antibiotics for limited selected patients (Q.4, $n = 47$, 100%). Details of the clinical scenarios can be seen in Q.4II (Table 3), which were systemic complications and acute apical abscess ($n = 25$, 78.1% and $n = 23$, 71.9%; respectively), followed by symptomatic apical periodontitis ($n = 9$, 28.1%), chronic apical periodontitis ($n = 6$, 18.8%), symptomatic irreversible pulpitis ($n = 3$, 9.4%), and symptomatic reversible pulpitis ($n = 1$, 3.1%). The “other” G2 answers for indications of antibiotics ($n = 6$, 18.8%) were described as: immuno-compromised patients ($n = 1$), conditions where local treatment (such as drainage) was not possible ($n = 3$), and apical periodontitis secondary to failed primary root canal treatment ($n = 2$). However, when G2 was asked about their knowledge of guidelines for antibiotic prescribing in endodontics, only 9 of 32 (28%) of the responders were aware of their existence (Q. 5 I), with 7 out 9 having read the guidelines (Q.5 II).

When analyzing the answers to the specific clinical scenarios (Q 7-12, Figure 1), it was observed that for Q7, 75% ($n = 35$) of G1 and 35% ($n = 11$) of G2 would prescribe antibiotics unnecessarily for cases of necrotic pulps with symptomatic apical periodontitis without systemic complications (incorrect indication). For Q.8, 98% ($n = 45$) of G1 would not prescribe antibiotics for failed root canal treatment associated with symptoms without systemic involvement (correct indication) whereas 58% ($n = 18$) of G2 would prescribe them (incorrect indication). Similarly, 95% ($n = 44$) of G1 would not prescribe antibiotics for teeth with necrotic pulps and asymptomatic apical periodontitis for patients with a history of rheumatic fever (ideal answer) but approximately 28% of G2 ($n = 9$) would prescribe them (incorrect indication). The answers for Q.10 revealed that 25% ($n = 11$) of G1 and 30% of G2 ($n = 11$) would prescribe antibiotics to treat teeth with symptomatic irreversible/reversible pulpitis and failure to achieve anaesthesia (incorrect indication). Q.11 revealed that the majority of G1 (90%; $n = 43$) and G2 (80%, $n = 25$) would not prescribe antibiotics for a chronic apical abscess for patients with diabetes without systemic involvement (correct answer – no antibiotics is indicated in this situation). The last clinical scenario (Q.12) revealed that 95% of G1 ($n = 46$) and 75% ($n = 24$) of G2 believed

that antibiotics were necessary for cases with signs of infection spreading (risk of cellulitis), which can affect vital functions such as breathing (correct answer – antibiotics are indicated in these cases).

When comparing G1 and G2, there was a significant difference in the awareness of antibiotic guidelines between the two groups ($P < 0.05$). The RR coefficient showed that G1 were 2.118 times more likely to be aware of the guidelines compared to G2. There was no evidence of a significant difference between the two groups in their awareness of the consequences of antibiotic over-use ($P \geq 0.05$). For Q.7, G1 were more likely to prescribe antibiotics compared to G2 ($P < 0.05$, RR = 2.166, 95% CI: 1.305–3.597). The same was found for Q12 ($P < 0.05$, RR = 1.305, 95% CI: 1.064–1.601). On the other hand, G1 were less likely to prescribe antibiotics for Q8 ($P < 0.001$) and Q9 ($P < 0.05$) with RR equal to 0.076 (95% CI: 0.019–0.304) and 0.227 (95% CI: 0.067–0.774) respectively. For Q.10 and Q.11 there was no significant difference between the groups ($P \geq 0.05$).

Discussion

The present study aimed to evaluate the views of final year BDS students at Cardiff University (G1) and general dental practitioners (GDPs) within Cardiff, Wales (G2) on antibiotic use for endodontic conditions through an online survey.

Online surveys are easy to access, rapid and economical for data collection (Fricker & Schonlau 2002, Heiervang & Goodman 2011). Bristol Online Survey (BOS; <https://www.onlinesurveys.ac.uk/>) fulfill all these requirements and is secure; it also complies with the UK data protection law (DPA 1998). The platform was designed for academic research, education and public-sector organizations. It is widely used by over 300 organizations, including 130 UK universities (BOS 2015). Questionnaires are economic and efficient methods of collecting data (Kelley *et al.* 2003), but respondents may report optimistic information about their practices by distorting reality (Boynton & Greenhalgh 2004). Furthermore, cross-sectional questionnaire studies only represent a 'snapshot' of participants' views at a particular time (Kelley *et al.* 2003).

Prior to the survey being launched, a pilot study with 10 participants was carried out to validate the questions/answers. Although a pilot or feasibility study does not ensure complete success in a main study, it provides an early indication of adjustments that may be needed to the questions (Van Teijlingen & Hundley

2002). For example, a minor adjustment on Q2 was required to make clear the intervals of time for the qualifications of dentists.

A response rate of 70-80% is desirable to reduce non-response bias (Evans 1991, Christie *et al.* 1997). Response rates may be influenced by differences between participants and non-participants, survey subject, target group type/interest, sample selection/size, survey design and techniques (Parashos *et al.* 2005). The total response rate on this survey was 60.3%, which was comparable to other survey studies in the literature (Palmer *et al.* 2000, Rodriguez-Núñez *et al.* 2009, Segura-Egea *et al.* 2010, Cunningham *et al.* 2015). A reminder was sent to encourage participation and resulted in an improvement of 22.1%, agreeing with Barclay *et al.* (2002) and Nulty (2008).

In the present study a small percentage of students who would never prescribe antibiotics (Q.4 I) this could be a misinterpretation of the questions or a lack of knowledge since they are not licensed to prescribe antibiotics at this stage of their training. Although an acute apical abscess does not require antibiotics and local dental treatment is sufficient to manage the condition (SDCEP 2011, AAE 2016, ESE 2017, Segura-Egea *et al.* 2017), high numbers of G1 participants believed that an acute apical abscess was an indication for antibiotics (Q.4 II), the trend to overuse antibiotics in this situation was in agreement with Martín-Jimenez *et al.* (2018) study who reported that the vast majority of final year students would prescribe antibiotics when a swelling was present. Therefore, one could speculate that those students after qualification, could contribute to the unnecessary prescribing of antibiotics for such a condition.

In the hypothetical case scenarios, it was noticeable that the majority of the final year students would prescribe antibiotics to treat teeth with necrotic pulps and symptomatic apical periodontitis (75%), similarly Martín-Jimenez *et al.* (2018) reported that 44% of final year students in Spain would also prescribe antibiotics to treat this condition. The number of students who would misuse antibiotics to treat irreversible pulpitis (Q.10) was much lower (25%) in the present study compared to those in the Martín-Jimenez *et al.* (2018) study (63%). This difference could be attributed to differences in the undergraduate curriculum, or most likely to the methodology used to obtain the answers. Martín-Jimenez *et al.* (2018) provided the diagnosis to the students to make their decisions, this means students would need to recall what clinical manifestations each diagnosis

would represent, whereas case scenarios were given in the present study and the students had to reach their own diagnosis to decide on the use of antibiotics.

The results of this study revealed that more than a third of G1 and a large proportion of G2 were not aware of the various guidelines. This emphasizes the need to include these in undergraduate endodontic education and as part of continuous professional development for dentists.

A considerable number of G1 participants believed that a patient feeling 'feverish' was an indication of systemic involvement. This illustrates the lack of objective assessment of systemic complications by many in G1. The analysis of G2 revealed the majority would prescribe antibiotics for systemic complications and acute apical abscess, whilst the minority would prescribe antibiotics for symptomatic apical periodontitis, chronic apical periodontitis, symptomatic irreversible pulpitis and symptomatic reversible pulpitis. These results confirm previous studies in Belgium and Lithuania, which indicated that 2-4% of participating dentists believed that antibiotics were indicated for the treatment of pulpitis (Mainjot *et al.* 2009, Skučaitė *et al.* 2010).

The clinical scenarios (Q.7-Q.12) were designed to reflect controversial clinical cases with a variety of clinical presentations. Questions/answers were designed to include both quantitative data (options were: antibiotics indicated or antibiotics not indicated) and qualitative data (space was provided for participants to clarify their answers). In the clinical scenarios (Q.7-11) antibiotic prescribing was not indicated.

Q.7 described a patient who was feeling 'feverish' before treatment, whose dental treatment had already been started by a clinician on the day of presentation. The word 'feverish' was included to assess the participants' assessment of systemic complications. Systemic complications can be a vague description (AAE 2016), and clinicians have to implement an objective method to assess such complications to limit antibiotics to those who are at risk of the spread of systemic infection (Robertson *et al.* 2015).

The analysis of the first clinical scenario (Q.7) revealed that almost two thirds of G2 were not in favor of antibiotic use, which is the ideal answer.

The use of antibiotics in case scenarios of failed root canal treatment (Q.8) associated with symptoms without systemic complications are not indicated (Segura-Egea *et al.* 2017), however, some clinicians believed

otherwise (Abbott 2000). Several G2 participants justified antibiotic prescribing because of the difficulties of carrying out local treatment due to pain and/or time availability at emergency clinics. It was interesting to note that these factors (pain and time availability) were highlighted in a previous cross-sectional study as factors, which influence antibiotic prescribing by GPs (Cope *et al.* 2015). There is accumulating evidence to indicate that there are effective alternative methods to control pain such as providing local treatment and/or analgesics (Fouad 2002, Keiser & Hargreaves 2002, Keenan *et al.* 2006, Fedorowicz *et al.* 2013, Agnihotry *et al.* 2016).

Q.9 aimed to assess knowledge on prophylactic use of antibiotics for patients with a history of rheumatic fever and diagnosis of necrotic pulp and asymptomatic apical periodontitis. The NICE guidelines (2008, 2015, 2016), and the latest European Society of Endodontology position statement for antibiotic use in endodontics (ESE 2017) do not recommended the use of antibiotics in these circumstances. Approximately a third of the G2 subjects considered a history of rheumatic fever as a high-risk condition and would prescribe antibiotics, despite the latest guidelines (NICE 2008, 2015, 2016, ESE 2017).

Failure to achieve anaesthesia does not indicate the use of antibiotics (Q.10). Some of G2 would prescribe antibiotics in cases where local anaesthesia was not effective because they believed that the presence of bacterial infection prevented local anaesthesia working without even attempting alternative anaesthetic approaches. There are many causes and hypotheses for failed local anaesthesia, such as the presence of accessory nerves, central core theory, ion trapping, and anxiety (Virdee *et al.* 2015a). The prescription of antibiotics in such cases is often a common clinical decision (Virdee *et al.* 2015a). However, the correct approach is to use alternative methods for achieving anaesthesia (Virdee *et al.* 2015b). Similarly, some GPs would use antibiotics because they believed that the presence of pus indicated a bacterial infection, or because the patient was suffering from a diabetic condition.

Q.12 was the only scenario where the use of antibiotics was required due to the signs of a spreading infection (risk of cellulitis) and the associated risk of infection in dangerous regions, which can affect vital functions such as breathing (SDCEP 2011, AAE 2016 ESE 2017). The majority of G2 would prescribe antibiotics in this situation but a quarter of the participants would not and justified their choice by providing local treatment and / or 24-hour monitoring.

Overall, the results indicated a lack of proper use of antibiotics by the GDP group. The results are comparable to other studies that indicated antibiotics were prescribed inappropriately (Whitten *et al.* 1996, Abbott 2000, Palmer *et al.* 2000, Cope *et al.* 2015). A cross-sectional study, which assessed whether GDPs in Wales prescribed antibiotics according to guidelines, revealed that only 19% of the antibiotics prescribed were indicated by the guidelines (Cope *et al.* 2015). Furthermore, the authors reported that failed initial management, time constraints, patient wishes, and acute periodontal conditions were factors that contributed to antibiotic usage in the absence of infections. However, that study (Cope *et al.* 2015) had a cross-sectional design and included only the first 45 GDPs who responded out of a target group of 200. There was evidence of a degree of selection bias and with the sample not being representative of all Welsh-based GDPs. Nevertheless, this study did highlight the general over-use of antibiotics in general dental practices within Wales. Rodriguez-Núñez *et al.* (2009) reported that 40% of members of the Spanish Endodontic Society used antibiotics for irreversible pulpitis, and approximately 50% reported they would prescribe antibiotics for acute apical periodontitis without swelling, associated with necrotic pulps.

Both groups in the present study were aware of the global antibiotic resistance crisis and there was no evidence of significant differences between the two groups in relation to their awareness of the consequences of antibiotic over-use ($P \geq 0.05$). However, there was a difference in the awareness of antibiotic guidelines between the G1 and G2 groups ($P < 0.05$), with the RR coefficients revealing that G1 were 2.118 times more likely to be aware of the guidelines compared to G2. Although most of the antibiotic guidelines in the literature are open access and free on the internet, searching and reading these guidelines requires a degree of interest and effort, whereas students are required to be aware of these guidelines for assessment purposes. This could explain the observed difference between students and GDPs.

A significant difference was observed between G1 and G2 in Q8 and Q9 (ideal answer = antibiotic not indicated); ($P < 0.05$) where G1 were less likely to prescribe antibiotics than G2. These results confirmed the overall over-use of antibiotics in general dental practice and are comparable to other studies (Whitten *et al.* 1996, Abbott 2000, Palmer *et al.* 2000, Mainjot *et al.* 2009, Rodriguez-Núñez *et al.* 2009, Skučaitė *et al.* 2010, Cope *et al.* 2015). On the other hand, there was no statistical evidence to suggest that there was a difference between G1 and G2 in Q10 and Q11 ($P \geq 0.05$).

Clinical experience may have an effect on attitudes to antibiotic prescribing, this was reflected in Q.7 where GDPs were less likely to prescribe antibiotics compared to final year BDS students ($P < 0.05$). It indicated that GDPs were more effective than students when assessing systemic involvement. The majority of G1 interpreted 'feverish' as systemic involvement. This was replicated in the relative risk calculations, and indicated that the final-year BDS subjects were 2.166 times more likely to prescribe antibiotics than GDPs in this situation. Likewise in Q.12 the G1 group were 1.305 times more likely to prescribe antibiotics than G2, however, the ideal answer approved antibiotic prescribing in this condition due to the risk of infection spread. In this instance, the experience of GDPs seems to have influenced their decision negatively compared to final year BDS students.

Conclusion

In the era of the antibiotic crisis, the clinical practice of prescribing antibiotics instead of providing local dental treatment or the use of antibiotics as a pain relieving medicine must be discontinued, as antibiotics do not relieve pain (Abbott 2000, Segura-Egea *et al.* 2017). Within the limitations of this survey conducted in the Cardiff area of the UK, the potential misuse of antibiotics by final year dental students and GDPs to treat endodontic infections has been highlighted. Future studies with larger sample size and larger geographic regions are required. Nonetheless, specific guidelines on the use of antibiotics in endodontics must be included in undergraduate education, as well as in the continuous professional development of GDPs during the management of pulpal and periapical diseases to decrease the misuse of antibiotics.

Conflicts of interest

The authors declare no conflicts of interest.

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Acknowledgement

We would like to express our thanks and appreciation to all participants who completed the survey.

Table 1: Questionnaire used to evaluate antibiotic prescribing for endodontic therapies.

| No. | Question | Given answers |
|---------|--|--|
| Q.1 | Name of the dental school you qualified from (GDP) or that you expect to qualify from (student): | N/A |
| Q.2: I | Occupation: | Final BDS student Qualified Dentist |
| Q.2: II | The number of years of clinical experience after qualification: | a) 0 years b) Less than 1 year c) 1-5 years d) 6-10 years e) More than 10 years |
| Q.3: I | The number of patients that you see per full working day is: | 0-5 6-10 11-20 21-30 31-40 More than 40 |
| Q.3: II | The number of endodontic emergency patients that you see per full working day is: | 0-3 4-6 7-9 10-12 13-15 More than 15 |
| Q.4: I | How frequently do you prescribe antibiotics for endodontic problems? | To a limited selected number of patients To most patients To all patients Never |
| Q.4: II | In what endodontic conditions would you prescribe antibiotics? | Symptomatic reversible pulpitis Symptomatic irreversible pulpitis Symptomatic apical periodontitis Chronic apical periodontitis Acute apical abscess Systemic complications (e.g., fever, malaise) Never Other (please specify) |
| Q.5: I | Are you aware of any available guidelines for prescribing antibiotic for endodontic conditions? If you answered yes, please describe the guidelines that are you are aware off. | a) Yes b) No |
| Q.5: II | Have you read these guidelines? | a) Yes |

| | | |
|------|--|---|
| | | b) No |
| Q.6 | <p>Are you aware of the consequences of the over-use of antibiotics?</p> <p>If you answered yes, please can you describe the possible consequences of antibiotics over-use</p> | <p>a) Yes</p> <p>b) No</p> |
| Q.7 | <p>Clinical scenario:</p> <p>"A 23 year old female patient complains of severe throbbing localised dental pain related to UR 4. She feels feverish since yesterday. Clinical examination reveals no swelling nor sinus tract. However, UR 4 buccal sulcus is tender on palpation and the tooth is tender to percussion. UR 4 is negative to cold and electric pulp testing. Radiographic examination of UR 4 reveals a small apical radiolucency. The treatment plan was to carry root canal treatment on UR 4, which you started today."</p> | <p>a) Antibiotic indicated</p> <p>b) Antibiotic not indicated</p> |
| Q.8 | <p>Clinical scenario:</p> <p>"A 35 year old female patient could not sleep for three nights because of painful upper right tooth that presents with dull constant severe generalised pain on the upper right side. UR 6 was previously root filled 9 years ago. UR 6 is grossly carious and is tender to touch. It is also mobile grade II. Radiographic examination indicates a root filling with voids and the filling is short of the radiographic apex by 5mm. She wants to save the tooth and to have root canal re-treatment. However, the tooth is extremely painful even to a light touch."</p> | <p>a) Antibiotic indicated</p> <p>b) Antibiotic not indicated</p> |
| Q.9 | <p>Clinical scenario:</p> <p>"A 58 year old male patient attends your dental clinic for the first time for a 12 month check-up. On examination, LR 7 and LR 6 have large leaking amalgam restorations. However, radiographic examination reveals large apical lesions on both teeth. You have explained to the patient all of the possible treatment options and he wishes to have primary root canal treatment on LR7 and LR 6. The patient is fit and well. However, his medical history shows a history of rheumatic fever 28 years ago."</p> | <p>a) Antibiotic indicated</p> <p>b) Antibiotic not indicated</p> |
| Q.10 | <p>Clinical scenario:</p> <p>"Your clinic colleague asked you for advice regarding a 27 year old male patient who is fit and well. The patient has a sharp pain that is localised to LL 7. Radiographic examination indicates dental caries extending to the pulp chamber with no apical radiographic changes. Your colleague decided to preform partial pulpotomy after obtaining consent from the patient. However, the tooth could not be anaesthetised after attempting inferior dental nerve block twice (2 x cartilage of 2% Xylocaine, with 1:80, 000 adrenaline), although the patient lips feels numb."</p> | <p>a) Antibiotic indicated</p> <p>b) Antibiotic not indicated</p> |

- Q.11 Clinical scenario:
“A 62 year old poorly controlled diabetic male patient presents with dull mild discomfort localised to UR 3, which is not tender to palpation and is not mobile. There is pus discharge through a buccal sinus. The treatment plan is to carry out root canal treatment and to avoid extraction.”
- a) Antibiotic indicated
b) Antibiotic not indicated
- Q.12 Clinical scenario:
“A 25 year old male patient complains of dull localised pain and swelling associated with deep caries in LR 7. On examination, LR 7 is negative to cold and electric pulp testing. However, a periapical radiograph shows widening of periodontal ligaments associated with LR 7. A diffused redness on the lingual mandibular wall related to LR 7 is noted and it is spreading to the floor of the mouth.”
- a) Antibiotic indicated
b) Antibiotic not indicated

Questions 1, 4 (II), 5 (I), 6, 7, 8, 9, 10, 11, and 12 had open ended sections for clarifications/justifications.

Table 2: Summary of information of the questionnaire.

| | Purpose of question | Diagnosis | Answer | Justification |
|---------|---|---|------------------|---|
| Q.1 | Identify name of school of qualification | N/A | N/A | N/A |
| Q.2: I | Locate study groups | N/A | N/A | N/A |
| Q.2: II | Identify years of experience | N/A | N/A | N/A |
| Q.3: I | Identify number of seen patients per day | N/A | N/A | N/A |
| Q.3: II | Identify number of seen endodontic emergency patients per day | N/A | N/A | N/A |
| Q.4: I | Identify antibiotic prescription attitude in endodontics | N/A | Limited cases | Limited endodontic conditions require antibiotics |
| Q.4: II | Which endodontic conditions indicates antibiotics | N/A | Systemic involve | Systemic involvement is an indication |
| Q.5: I | Awareness of guidelines | N/A | Yes | N/A |
| Q.5: II | Guideline have been read? | N/A | Yes | N/A |
| Q.6 | Over-use consequences | N/A | N/A | N/A |
| Q.7 | Clinical scenario: Necrotic pulps/symptomatic AP without systemic complications | Necrotic pulp, Symptomatic AP | (b) | Require systematic method of assessing systematic involvement, active treatment was initiated |
| Q.8 | Clinical scenario; Failed RCT associated with symptoms without systemic involvement | Previously RT, Symptomatic AP | (b) | Active treatment (re-treatment/pain are not an indication) |
| Q.9 | Clinical scenario; Prophylaxis (History of rheumatic fever) | Necrotic pulp, Asymptomatic AP | (b) | No indication for antibiotic prophylaxis |
| Q.10 | Identify antibiotic indication; Failure to achieve anaesthesia (Hot Pulp) | Dental caries, symptomatic irreversible/reversible pulpitis | (b) | Clinician should have a systematic approach such as using alternative methods |
| Q.11 | Identify antibiotic indication; Chronic apical abscess and diabetes status without systemic involvement | Necrotic pulp, Chronic apical abscess | (b) | No indication for antibiotic prescription, need to liaison with patient physician |
| Q.12 | Identify antibiotic indication; Signs of infection spreading (risk of cellulitis) which can effect vital function such as breathing | Dental caries, Necrotic pulp, acute apical abscess | (a) | There is a risk of infection spread to dangerous regions, which can effect vital function |

N/A: Not Applicable, AP: Apical Periodontitis, (a): Antibiotic is indicated, (b): Antibiotic is not indicated

Table 3. G1 and G2 summary of answer for questions 1 to 6

| Questions | | G1 (n=47) (BDS) | G2 (n=32) (GDP) |
|---------------|---|--------------------|--------------------|
| Q.1 | Identify name of school of qualification | | |
| | Cardiff Dental School, Wales, UK | 47 | 19 |
| | Advanced Polytechnic and University Cooperative, Gandra, Portugal | 0 | 1 |
| | Barts the London School of Medicine and Dentistry, England, UK | 0 | 1 |
| | Birmingham Dental School, England, UK | 0 | 1 |
| | Bristol Dental School, England, UK | 0 | 1 |
| | Colombia (no further details provided) | 0 | 1 |
| | Cork Dental School, Ireland | 0 | 2 |
| | Ghent University Dental School, Belgium | 0 | 1 |
| | Greece (no further details provided) | 0 | 1 |
| | Kings College London, England, UK | 0 | 1 |
| | Liverpool Dental School, England, UK | 0 | 1 |
| | Manchester Dental School, England, UK | 0 | 1 |
| | Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, India | 0 | 1 |
| Q.2 | Locate study groups | 47 | 32 |
| Q.2 II | Identify years of experience | | |
| | 0 years | 47 | 0 |
| | < 1 year | 0 | 0 |
| | 1-5 years | 0 | 7 |
| | 5-10 years | 0 | 10 |
| | >10 years | 0 | 15 |
| Q.3 I | Identify number of patients per day | | |
| | 0 - 5 | 43 | 0 |
| | 5 -10. | 4 | 2 |
| | 10 - 20 | 0 | 10 |
| | 20 - 30 | 0 | 10 |
| | 30 - 40 | 0 | 9 |
| | > 40 | 0 | 1 |
| Q.3 II | Identify number of seen endodontic emergency patients per day | | |
| | 0 - 3 | 47 | 29 |
| | 3 - 6 | 0 | 3 |
| Q.4 I | Identify antibiotic prescription attitude in endodontics | | |
| | Limited number of patients | 39 | 32 |
| | Never | 8 | 0 |
| Q.4 II | Which endodontic conditions indicates antibiotics | | |
| | Acute apical abscess | 30 | 23 |
| | Systemic complications | 47 | 25 |
| | Symptomatic reversible pulpitis | 0 | 1 |
| | Symptomatic irreversible pulpitis | 0 | 3 |
| | Symptomatic apical periodontitis | 0 | 9 |
| | Chronic apical periodontitis | 0 | 6 |
| | Other: | 3 | 6 |
| | Immunocompromised, spreading infection, not effective local Trestment | 1 | 1 |
| | If drainage of swelling cannot be achieved | 1 | 3 |

| | | | |
|---------------|---|-----------|-----------|
| | Apical periodontitis – secondary to failed primary root canal treatment | 1 | 2 |
| Q.5 I | Awareness of guidelines | 28 | 9 |
| Q.5 II | Guideline have been read? | 18 | 7 |
| Q.6 | Over-use consequences | 47 | 31 |

G1: BDS - Final Year Dental Students and G2: GDP - General Dental Practitioners